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The problems of energy transport and its multi-scale impact in the intracluster medium

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Energy transport across a wide range of dynamical scales in the intracluster medium is one of the most interesting topics in current research and future interest. Hot baryons, visible in the X-rays, need to be stably sustained against radiative cooling over a large inner fraction of the cluster virial radius. A historical motivation has been the lack of sufficient observed cold gas in the cluster cores that is expected in the absence of efficient heating. Quantitatively, there is enough energy from active galactic nuclei to solve the problem at the simplest level, but the complexity of how that energy flows around is not well understood. Multiple transport mechanisms are being actively discussed including long wavelength, nearly isotropic sound waves, anisotropic heat conduction along local magnetic fields (depending on the local temperature gradient), generation and dissipation of volume-filling turbulence, etc. While sound waves and turbulence have been strong contenders, thermal conduction has been claimed to be further suppressed by gyro-scale whistlers that scatter thermal electrons efficiently in the weakly magnetised ICM. In the latter scenario, thermal instability domain may be enhanced leading to excess and/or smaller scale cold gas. This further implies that observations may need to account for excess cold/mixed phase gas. In my talk, I will discuss these topics of energy transport in the ICM and the consequences.

Primary author: PAL CHOUDHURY, Prakriti (Institute of Astronomy, University of Cambridge)

Presenter: PAL CHOUDHURY, Prakriti (Institute of Astronomy, University of Cambridge)

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